Bacteria + Fungi = More Peas?

Higher yields could be in store for pea crops as U.S. and Russian scientists cooperatively field-test an experimental inoculant and new strains of microbe-friendly peas.

Scientists with the Agricultural Research Service (ARS) and the All-Russia Research Institute for Agricultural Microbiology (ARRIAM), in St. Petersburg, are conducting the tests as part of a 3-year project funded by the North Atlantic Treaty Organization's division of Life Science and Technology, which oversees a program to facilitate cooperative research between scientists of NATO countries and Russia.

"The objectives include using microbes that interact favorably with pea plants to provide needed nutrients, such as nitrogen and phosphorus. Specifically, it involves inoculating pea seed with *Rhizobium* bacteria and mycorrhizal fungi," says plant geneticist Fred. J. Muehlbauer. A second objective is to identify pea varieties that are especially adept at forming symbiotic relationships with these microbes. Muehlbauer coordinates the U.S. end of the study from ARS's Grain Legume Genetics and Physiology Research Unit in Pullman, Washington—a state where much of the nation's $68 million dry edible pea and lentil crop is grown. Alexey Y. Borisov, Muehlbauer's main Russian counterpart, is a microbiologist specializing in legume-microbe interactions at ARRIAM.

Their two-pronged approach is a new twist on a decades-old practice among legume farmers. In cultivated peas, for example, farmers inoculate their crop's seed with *Rhizobium* bacteria, but not mycorrhizal fungi. The bacteria supply the pea plants with nitrogen fixed from the air when the soils are deficient in that nutrient. In other crops, the fungi are called on to "mine" the soils for insoluble phosphorus, which the plants can't otherwise obtain. In either case, the practice helps farmers minimize the amount of fertilizer they need to add to their fields, which reduces costs and better protects the environment.

Muehlbauer and Borisov think this system can be improved by inoculating peas with both the bacteria and the fungi. Indeed, in recent field trials in the central Russian city of Orel, Borisov and associates observed seed yield increases of up to 30 percent in some of the 26 pea lines they tested and compared to uninoculated, control plants. In another case, an inoculated pea variety produced 25 percent bigger seeds than fertilized controls.

In April, Muehlbauer will simultaneously inoculate pea plants with the two microbes in field plots at Pullman to verify the approach's effectiveness in conditions other than those at Orel. Borisov is expected to run parallel experiments there.

Inoculating peas is only half the story, though. The other half involves using the inoculant on pea varieties that have certain traits that make it easier for the bacteria and fungi to do their respective jobs of capturing nitrogen and phosphorus.

"In this tripartite symbiotic system, the pea plant provides energy to the *Rhizobia* and mycorrhizae, and these microbes in turn provide the pea plant with the nutrients it needs for plant growth," Muehlbauer explains. "One of our objectives is to enhance this system through selection and breeding."

So far, they've identified five new strains of microbe-friendly peas. This followed careful screening of 26 pea varieties and breeding lines from ARS and Russian germplasm collections.

This spring, they'll field-test the five varieties—along with four commercial varieties and three germplasm lines—at experimental plots in Pullman and Orel. Specifically, they'll evaluate the peas' responses—including growth, yield, and seed size—to four treatments: *Rhizobium*-only inoculation, mycorrhizae only, *Rhizobium* plus mycorrhizae, and a nonfertilized, uninoculated control.

Muehlbauer estimates 10 years may be needed to develop pea varieties with improved tripartite symbiosis and to make them available to U.S. and Russian producers.

If the approach results in higher yields for pea crops, then similar benefits may follow in other legumes, including lentils, grown in the United States, Russia, and elsewhere.—By **Jan Suszkiw,** ARS.

This research is part of Plant, Microbial, and Insect Genetic Resources, Genomics, and Genetic Enhancement, an ARS National Program (#301) described on the World Wide Web at www.nps.ars.usda.gov.

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